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L5	0	correlithm and objects and quantum and @ad<"20020813"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/06/19 10:25
L6	5	correlithm and objects and @ad<"20020813"	US-PGPUB; USPAT; EPO; JPO; DERWENT; IBM_TDB	OR	OFF	2006/06/19 10:25
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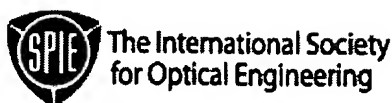
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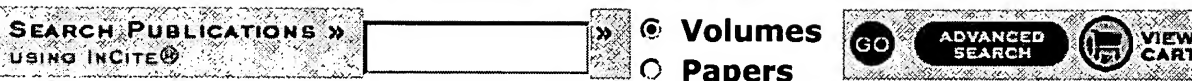
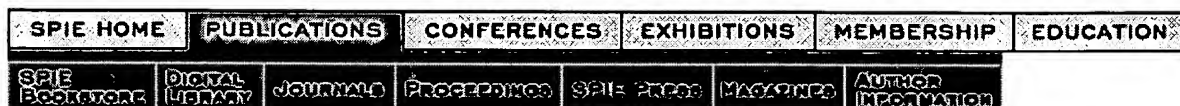
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## Abstract

### PUBLICATIONS

### Invariant quantum ensemble metrics

Douglas J. Matzke, P. Nick Lawrence

**Publication:** [Proc. SPIE Vol. 5815](#), p. 115-126, Quantum Information and Computation III; Eric J. Donkor, Andrew R. Pirich, Howard E. Brandt; Eds.

**Publication Date:** May 2005

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#### Abstract

We recently discovered when two ensembles of  $N$  qubits are initialized to random phases, then the Cartesian distance metric between the ensemble states is approximately  $\sqrt{2N}$ , with a standard deviation of  $1/2$ . This research relates inner product and quantum ensemble metrics to the "standard distance" metrics defined by correlithm object theory. Correlithm object theory describes how randomly selected points (or COs) in high dimensional bounded spaces can be used as soft tokens to represent states at the ensemble level. The initial CO research was

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performed using unit N-cubes, but under Air Force SBIR contract, we extended this theory for other bounded metric spaces such as binary N-spaces, complex N-spaces and Hilbert spaces. A quantum encoded CO can be created by initializing an ensemble of qubits based on a phase ensemble of uniformly distributed, randomly chosen phases with values from 0 to  $2\pi$ . If a quantum encoded CO token is created as a qubit ensemble Q initialized using a specific phase ensemble P, upon quantum measurement using another phase ensemble of basis states B it produces a binary ensemble A of measurement answers. Multiple trials using the exact same ensembles P and B generate answer ensembles that are correlated with each other, since their distance metric is 70.7% of the binary standard distance of  $\sqrt{N/2}$ . This means that quantum encoded CO tokens survive this measurement process. In contrast, choosing new random ensembles P or B for each trial generates uncorrelated answer ensembles. This paper describes and demonstrates how quantum measurement acts as a noise injection process from the correlithm object perspective.

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Slides presented at **Quantum** Mind II Conference in Tucson, AZ. This material is related to my boss's recent book "**Correlithm Object** Technology" by Nick P. ...

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